

ting muscular fascicles; *d*, radiating imparietal blood-channels; *d*, setæ.

Fig. 10. Liver-follicle of the Lobster, viewed by transmitted light: *a*, *b*, cæcal end, having glandulose walls by the swelling of the parietal epithelial cells; *c*, the secreted product in its first stage, oil-cells colourless and minute; *d*, *d*, the same increasing in size and becoming yellow in colour; *g*, oil-cell; *h*, yellow cell.

Fig. 11 is *fig. 12* enlarged. It shows the ultimate structure of the tentacle of a Prawn. The muscular masses occupy the axis, and the blood-corpuses course along the sides.

Fig. 13. Illustrates the mode in which the ultimate nerve-tubules are distributed in the gill-laminæ of several Crustacea: *b*, *c*, nerve-tubules; *e*, patches of parenchyma.

[To be continued.]

XXIX.—*Contributions to the Palæontology of Gloucestershire:—A description, with Figures, of some new Species of Echinodermata from the Lias and Oolites.* By THOMAS WRIGHT, M.D. &c., Professor of the Natural Sciences in the Cheltenham Grammar School*.

[With three Plates.]

[Continued from p. 173.]

Genus PEDINA, Agassiz.

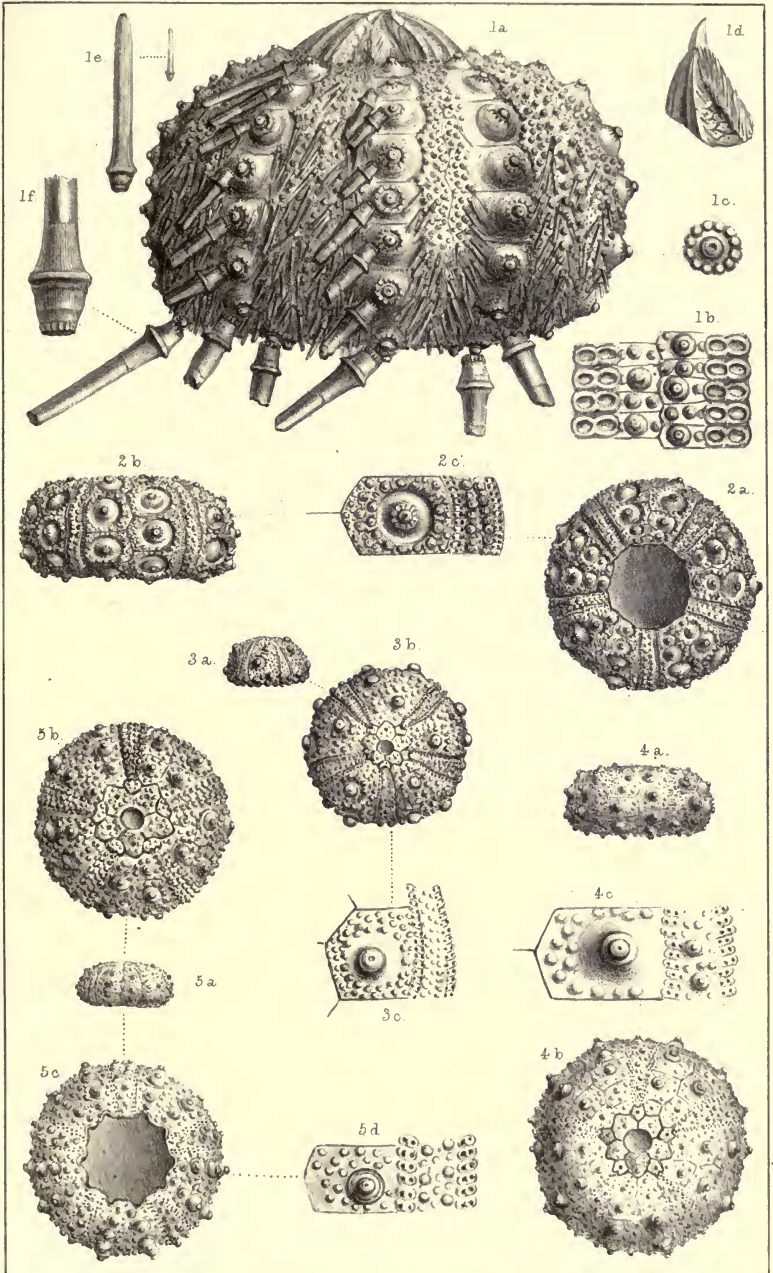
As this genus was incorrectly defined in our memoir on the Cidaridæ, it having been there stated that the mammillary eminences were “crenulated like those of *Diadema*,” we take this opportunity of correcting the error, and giving a definition more in accordance with our present knowledge.

Test thin, circular, more or less depressed; primary tubercles small and perforated; mammillary eminences with smooth ring-like summits without crenulations; pores in general disposed in triple oblique pairs; mouth small and slightly decagonal, margin not much notched; ovarial disc small and not prominent; ambulacral areas with one, two, or more rows of small tubercles; interambulacral areas sometimes with two rows only, sometimes with two rows and additional secondary rows of tubercles more or less complete.

This genus is extinct, and is found in the oolitic cretaceous rocks.

Pedina Bakeri, Wright. Pl. XI. fig. 4, *a-c*.

Test circular, depressed; ambulacral areas narrow, with one row of small tubercles disposed in a slightly zigzag line down the centre of the areas; interambulacral areas broad, with two rows of primary tubercles raised on prominent mammillary emi-

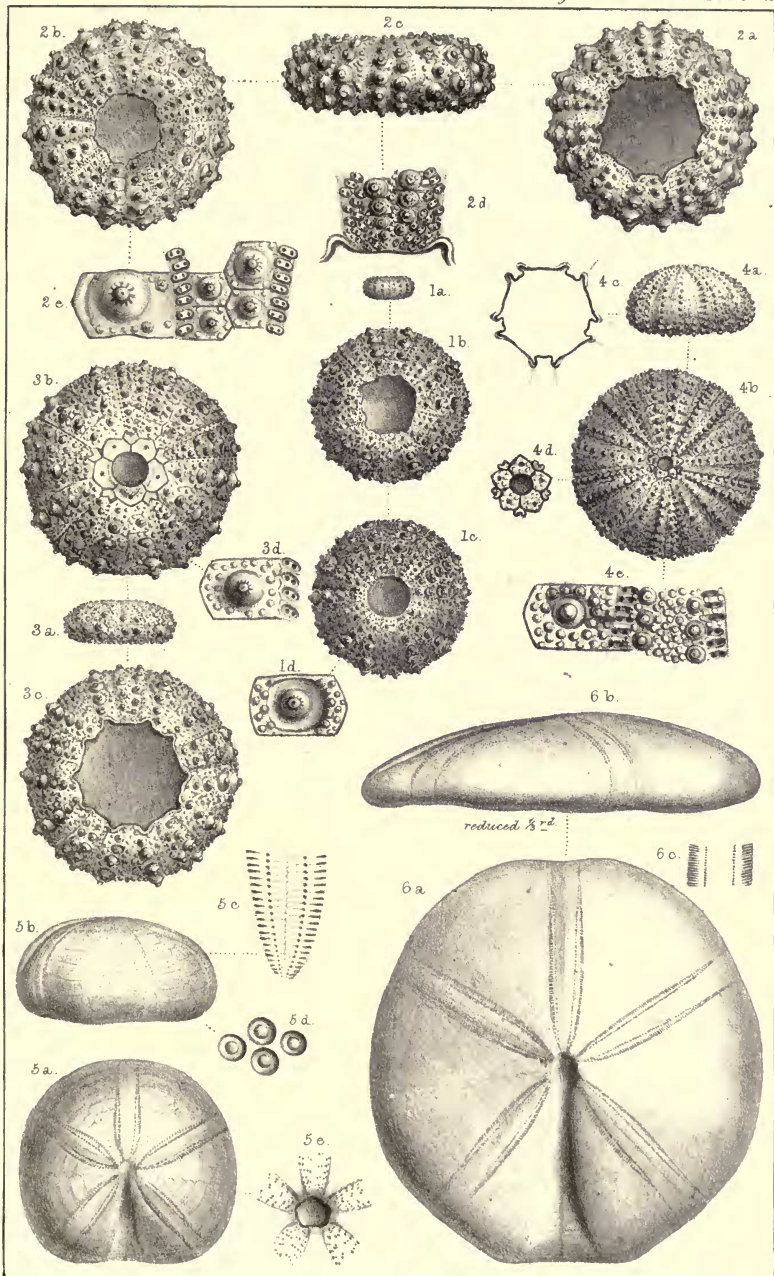


W.H. Bailey

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- | | | |
|--------|---------------------------|---------|
| 1 a-f. | <i>Cidaris</i> Edwardsoni | Wright |
| 2 a-c. | " Bouchardii | |
| 3 a-c. | <i>Hemicidaris</i> minor | Agassiz |
| 4 a-c. | <i>Pedina</i> Bakeri | Wright |
| 5 a-c. | " Etheridgei | |





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- 1 a,d. *Acrosalenia crinifera*
- 2 a,e. *Diadema Davidsoni*.
- 3 a,d. " *Moorei*.
- 4 a,e. *Polycyphus Deslongchampsii*.
- 5 a,e. *Nucleolites Woodwardi*
- 6 a,c. " *Michellini*

Wright

"

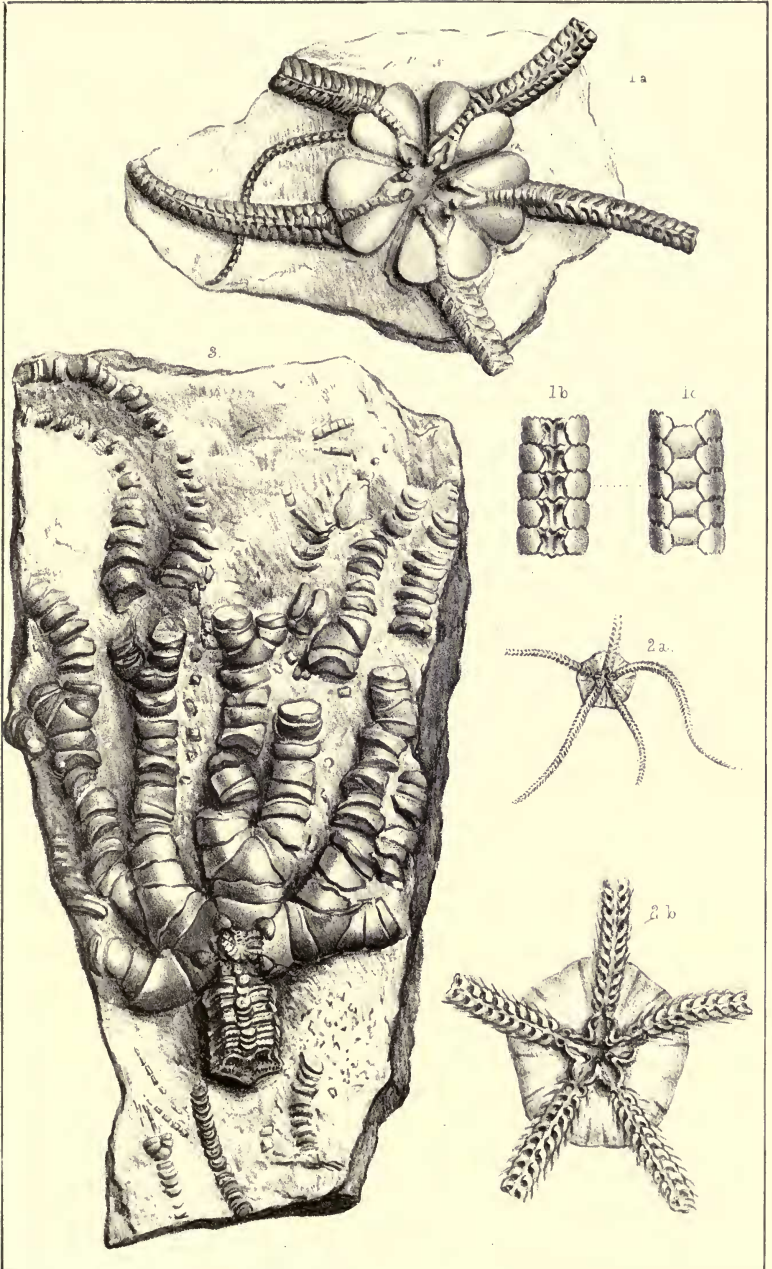
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W.H. Baile

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1 a.c. *Ophioderma Gaveyi*
 2. a, b. " *Griesbachii*
 3. *Pentacrinus Goldfusi*

Wright



nences in the centre of the plates; the margins of the areolas surrounded with circles of small granules; no secondary tubercles.

Height $\frac{7}{20}$ ths of an inch, transverse diameter $\frac{1}{2}\frac{5}{0}$ ths of an inch.

Description.—This *Pedina* presents a different form from its other congeners: the test is circular and depressed; the ambulacral areas are narrow, about one-third the width of the interambulacra; the usual double row of tubercles in this region is reduced to one row, the tubercles of which are disposed alternately on the right and left sides of the areas, thereby forming a single zigzag line down the centre thereof; the tubercles at the equator and on the upper surface are small, but there are two or three of a larger size at the base of the areas; a few granules form imperfect crescents round their narrow areolas. The interambulacral areas are nearly three times the width of the ambulacra; they are adorned with five pairs of primary tubercles of nearly a uniform size throughout, which are raised on prominent mammillary eminences, the summits of which are smooth, ring-like and without crenulations; circles of small granules bound the areolar spaces; there are no secondary tubercles, nor any sculpture upon the intertubercular surface of the plates, so that down the centre of the areas there is a smooth valley between the primary tubercles. The apical disc is well preserved in our specimen; the ovarial plates are of an irregular octagonal form and of moderate size, they are covered with a few granules scattered irregularly over their surface; the ocular plates are of a rhomboidal form and have large eye-holes. The base of the specimen is covered up with hard rock, so that it is impossible to expose the mouth-opening without endangering the specimen.

Affinities and differences.—The *Pedinae* have been so imperfectly described by M. Agassiz in his 'Descriptions des Echinodermes fossiles de la Suisse,' that there is much difficulty in making out the species figured and described in that monograph. When it is recollected how limited were the materials at Agassiz's command when he published that valuable contribution to Palæontology, and how delicate the test of this genus is, we can readily understand how so many different forms of the same Urchin came to be described and named as distinct species. After a careful examination of many specimens, we confess that *Pedina aspera*, *rotata*, *ornata* and *sublævis*, Agass., appear to us to be so many different forms of one and the same species. We have before us likewise the original type specimen of *P. granulosa*, Ag., which has been kindly communicated by Professor Deslongchamps. An examination of that Urchin has convinced us that it is only a larger individual of *P. aspera*, as we find it in

the Inferior Oolite, and is identical with the fossil which we have described as *P. rotata*. On a further examination of this specimen, M. Agassiz, it would appear, had arrived at a similar conclusion, for on the ticket which accompanies it is the following remark in his handwriting:—" *Pedina granulosa*, Ag. C'est sous ce nom que cette espèce est citée dans mon catalogue; cependant il se pourrait qu'elle ne fut qu'une variété un peu enflée de mon *P. aspera*." This species was collected by Prof. Deslongchamps from the Great Oolite of Ranville. We have likewise before us a portion of *Pedina* collected from the Oxford clay of the Boulonnais by M. Bouchard-Chantereaux, and marked by that eminent palæontologist, who kindly sent us the specimen, "Très rare. J'en ai encore trouvé que trois morceaux de cette espèce." It so nearly resembles the Ranville Urchin that we have no doubt of their identity. By the extreme kindness of M. Michelin and M. de Lorière, we have before us specimens of *P. Gervillii*, Ag., from the Kellovien étage of Chauffour, department of the Sarthe, which are identical with *Pedina aspera* or *rotata*, collected by us from the upper beds of the Inferior Oolite of Gloucestershire. In fact the French and English specimens are so entirely alike, that we should mistake the one for the other had we not previously marked them. It would appear from these remarks, that whether we retain the specific name *rotata* or *aspera* for this widely distributed Urchin, we must at least cancel the other names which have been given to various forms of the same, as we have now before us well-preserved specimens from the Inferior Oolite, Gloucestershire, the Great Oolite, Ranville, Calvados, the Oxford clay near Boulogne, Pas de Calais, the Kellovien of Chauffour, Sarthe.

[Since these sheets were sent to press, the Rev. A. W. Griesbach has communicated a *Pedina*, collected by him in the Cornbrash at Rushden, Northamptonshire; as this fossil is in a good state of preservation, we have been able to make a careful comparison of it with a fine *P. aspera* now before us, and there can be no doubt of their identity. The discovery of this Urchin in the Cornbrash is another link in the chain of evidence showing the wide stratigraphical range of this form in the Oolitic seas.]

P. Bakeri differs so entirely from the forms named in the preceding remarks, that it is impossible to mistake it for either of them; its diagnostic characters consist of the size and small number of the primary tubercles, the absence of secondary tubercles, the scanty granulation on the interambulacral areas, the narrowness of the ambulacra, and the single row of tubercles thereon. We have only met with the small but tolerably perfect specimen of this species figured (Pl. XI. fig. 4, a-c).

Locality and stratigraphical range.—We collected this rare

form of *Pedina* from the Pea-grit of Crickley Hill, and have seen fragments of its test in the same bed at Leckhampton, but never in any other locality.

We dedicate this species to our friend T. Barwick L. Baker, Esq., of Hardwicke Court, the President of the Cotteswold Naturalists' Club, for the warm interest he takes in the progress of the Palæontology of Gloucestershire.

Pedina Etheridgii, Wright. Pl. XI. fig. 5, a-c.

Test circular, depressed; ambulacral areas with from six to eight small perforate tubercles at their base, and a double row of small granules on their upper surface; the interambulacral areas with primary tubercles only, the areolas of which are surrounded with regular circles of granules; pedal pores not numerous, arranged in nearly a single file with a slight elevation between the two pores of each pair; apical disc large; ovarial plates leaf-like; mouth-opening small.

Height $\frac{5}{20}$ ths of an inch, transverse diameter $\frac{1}{20}$ ths of an inch.

Description.—This pretty little Urchin has a circular outline in the young state, which in larger specimens inclines towards a pentagonal form; the base is flattened, and the upper surface of the test is much depressed. The ambulacral areas are narrow, and have from six to eight small perforated tubercles at their base, and a double row of from twelve to fourteen minute imperforate granules in each row on their upper surface, which in figure and size resemble those covering the other parts of the test; between the pedal pores of each pair is a small elevation; these collectively form a prominent moniliform line which extends from the margin of the disc to the mouth-opening; the pores are disposed in nearly a single file, and do not form the triple oblique pairs which we observe in the larger *Pedinae*. The interambulacral areas are about twice the width of the ambulacra; the rows of primary tubercles occupying the centre of the plates have seven tubercles in each row, they are small in size and are rendered prominent from being raised upon uncrenulated mammillary eminences, the bases of which are sharply defined and surrounded by complete circles of moderately sized and regularly arranged granules; the regular disposition of these granulations gives an air of decoration to this little species not observed among other congeneric forms; the entire absence of secondary tubercles from the areas renders the decoration more complete. The apical disc is large; the ovarial plates are widely rhomboidal, the oculars are small and heart-shaped, and the surface of both is covered with minute granules nearly as large as those which adorn the other parts of the test. The madrepori-

form tubercle makes a distinct elevation on the surface of the single plate, and the anal aperture is transversely oblong; the base is flat, the mouth-opening is small, and its margin is divided into ten nearly equal-sized lobes; the spines are unknown.

Affinities and differences.—In its general outline and depressed upper surface, with the pedal pores in nearly a single file, this little Urchin resembles a *Diadema*; from that group however it is distinguished by the rudimentary condition of the ambulacral tubercles, and the absence of crenulations from the summits of the mammillary eminences. It is distinguished from *P. Bakeri* by having small primary tubercles set more closely together, and in having a greater number in each row. From *P. aspera* it is known by having the upper surface more depressed, the pedal pores separated by a moniliform line of granules, and in the absence of secondary tubercles. It has a strong resemblance at a first glance to *Diadema Mooreii*, but an examination with the lens at once discloses the points of difference, which are these:—the ambulacral areas in *Pedina Etheridgei* have imperforate granules on their upper parts, whilst in *Diadema Mooreii* there are perforated tubercles; the moniliform line between the pedal pores in *P. Etheridgei* is absent in *D. Mooreii*; the mouth-opening is likewise much smaller in *P. Etheridgei* than it is in *D. Mooreii*.

Locality and stratigraphical range.—*P. Etheridgei* has been collected from the marlstone of Bredon Hill, Gloucestershire. Mr. Moore found it in the Upper Lias of Ilminster, and we have collected several specimens from the Pea-grit (Inferior Oolite) of Crickley and Leckhampton Hills, but have never seen a trace of this species in any of the upper beds; it seems therefore to have a limited vertical range between the marlstone and the basement-beds of the Inferior Oolite, and is one of the few species which lived in the Liassic and Oolitic seas.

We dedicate this species to our friend Mr. Etheridge, of the Bristol Museum, who has kindly assisted us in comparing our specimens with the fine series of Echinoderms under his care, and has likewise otherwise aided us in the most friendly manner in working out the subjects of these memoirs.

Genus POLYCYPHUS, Agassiz.

Small Urchins having a subglobular form; the upper surface of the test is covered with numerous small imperforate tubercles of a very uniform size; the base and basal angle are furnished with several tubercles of a size disproportionately large when compared with those of the upper surface; the pedal pores are disposed in a triple oblique series of pairs; the mouth is large and

pentagonal; the anal plates form a narrow prominent ring at the vertex, and the interambulacral areas are in general divided by a median depression.

Polycyphus nodulosus, Münster.

SYN. *Echinus nodulosus*, Goldfuss, Petrefact. Ger. tab. 40. fig. 16;
 Agassiz, Cat. Syst. p. 12.
Arbacia nodulosa, Agass. Prodróm.
Polycyphus nodulosus, Agass. & Desor's Cat. raisonné, Ann. Scien.
 Nat. tome vi. p. 361.

Test hemispherical; ambulacral areas a little more prominent than the interambulacral areas; ambulacra with from four to five rows, and interambulacra with from twelve to fourteen rows of small tubercles disposed in nearly parallel lines; bases of the ambulacra with twelve, those of the interambulacra with sixteen larger tubercles.

Height $\frac{7}{20}$ ths of an inch, diameter $\frac{11}{20}$ ths of an inch.

This pretty little Urchin was first described by Prof. Goldfuss from specimens named by Count Münster from the Oolites of Baireuth; the hemispherical test exhibits a disposition to assume a subpentagonal circumference from the greater prominence of the ambulacral areas; the surface of the test is divided into fifteen nearly equal lobes by the ten poriferous avenues, and the five depressions which divide the interambulacra down their mesial lines; these lobular divisions are more defined in young and small specimens than in large and old ones; the ambulacral areas are one half the width of the interambulacral, and have nine large tubercles at their base, and four or five rows of small tubercles at their widest part, which gradually diminish to three, two and one as we approach the apex of the area; the interambulacral areas are twice the width of the ambulacral, they have about twenty-four large tubercles at their base, and about twelve rows of small tubercles at their widest part, which gradually diminish by the disappearance of the external rows to ten, eight, six, four and two, as we trace the rows from the equator to the apex of the areas; the tubercles on the sides and upper surface of the test are nearly of a uniform size, they are arranged in rows, the tubercles are opposite each other and do not alternate as in some other genera. The interambulacral areas are each divided by a slightly depressed line into two lobes; these are separated from the ambulacral areas by straight narrow poriferous avenues, so that the test of this beautiful Urchin appears to consist of fifteen nearly equal lobes, those of the ambulacra being the most prominent and best defined, in consequence of the

depth of the poriferous avenues being greater than the sulcus which divides the interambulacra.

The mouth is large and decagonal, and lies in a concave depression in the base, surrounded by the larger tubercles which occupy this region of the test. The ovarial plates are small, and form a rather prominent ring around the anal opening; the eye-plates are small, but in some of the foreign individuals now before me the eye-holes are very distinct.

Affinities and differences.—This Urchin resembles *Arbacia Forbesii*, but may be distinguished from that species by having the ambulacral areas proportionately wider, the tubercles larger and opposite to each other, and the poriferous avenues having the pedal holes in triple oblique pairs; it belongs moreover to a newer rock of the Oolitic series.

Locality and stratigraphical range.—We know only one English specimen of this species, which was found in the Cornbrash by Mr. Buy near Sutton Benger, Wilts; on the continent it occurs in the Baireuthian Jurakalke, where it was found by Count Münster. It has been collected from the Great Oolite of Langrune by Prof. Deslongchamps and M. Tesson, and from the Calcaire à polypiers at Ranville by M. Michelin. We beg to record to each of these gentlemen our best thanks for the beautiful series of type specimens of this Urchin with which they have so liberally supplied us.

History.—Figured and described for the first time by Goldfuss. We are not aware that any detailed description of the species has been given before, with the exception of the very brief one contained in the 'Petrefacta Germaniæ.'

Polycyphus Deslongchampsii, Wright. Pl. XII. fig. 4, a-e.

Test hemispherical, circumference circular; ambulacral areas with two rows of larger and two rows of smaller tubercles; interambulacral areas with two rows of larger and several rows of smaller tubercles; the small tubercles in both areas often degenerating into mere granulations; basal tubercles large and prominent.

Height $\frac{7}{20}$ ths of an inch, transverse diameter $\frac{1}{2}\frac{5}{6}$ ths of an inch.

Description.—Amongst the many beautiful forms of Urchin structure, this pretty little species will bear comparison for neatness and symmetry with any of the family to which it belongs. We found the first specimen about eighteen months ago, and since then have added an interesting series to our collection. It must be a rare form, as only two or three specimens have been obtained besides those collected by ourselves. The ambulacral areas are one half the width of the interambulacral, and have one row of